

Electronics

1. Conservation Laws

Kirchhoff's Current Law: charge is conserved

Kirchhoff's Voltage Law: energy is conserved

Energy Flow: power generate = power dissipated

2. Element Laws

$$V=IR$$

$$Q=CV$$

...

3. Network Theorems

Thevenin Equivalent Network

Norton Equivalent Network

20.309 Special topics:

Time/freq response

Feedback

Op-amps

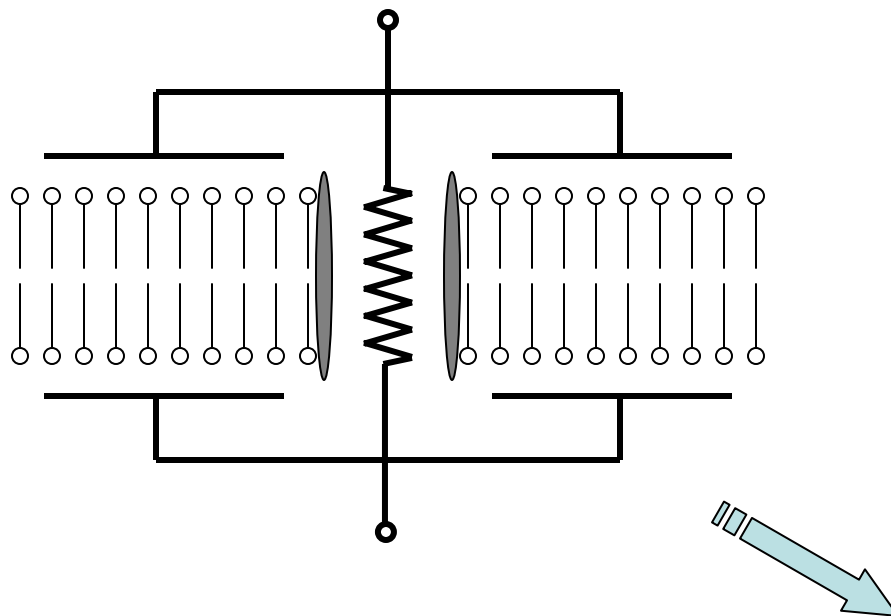
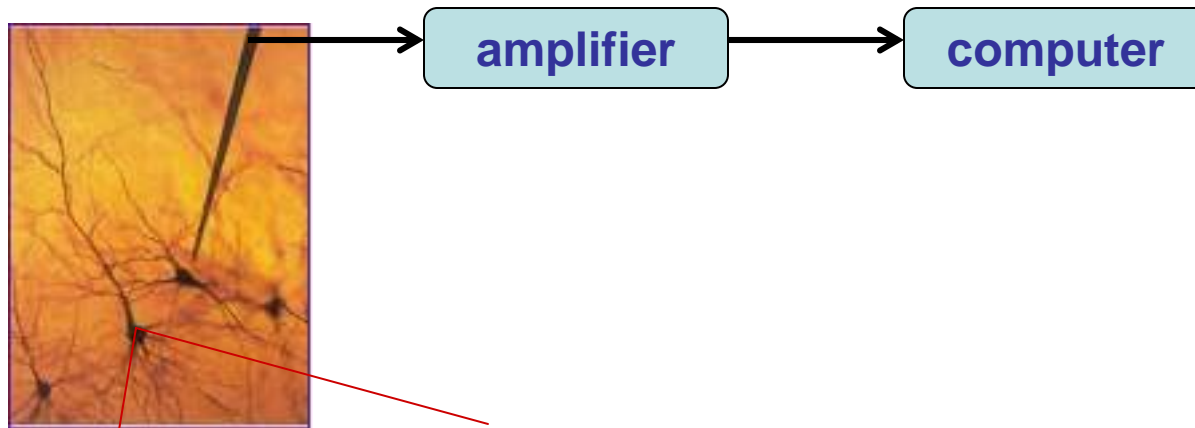
Foundations of Analog and Digital Electronic Circuits

Version 8.0

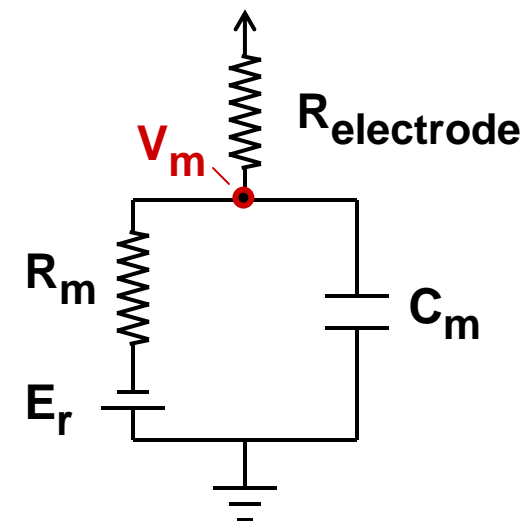
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Equivalent Circuit

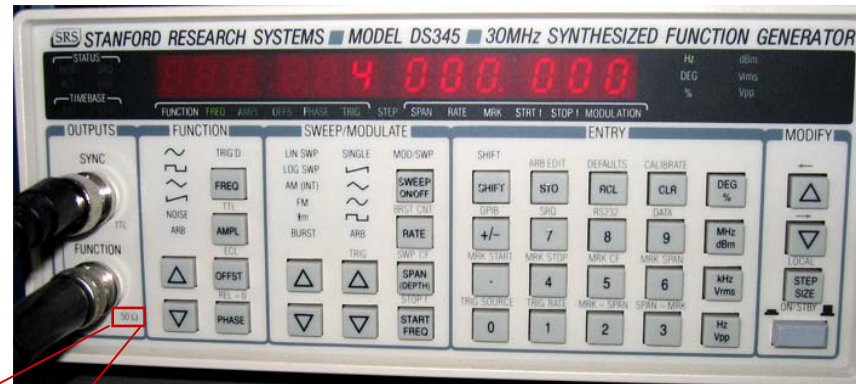


Oscilloscope



CH1 1M Ω // 25pF
300V CAT II

Function Generator



Microelectrodes Instruments

VF-180 MICROELECTRODE AMPLIFIER

The VF-180 is a high input impedance voltage follower for intracellular voltage measurements. The VF-180 has a current injection capability and possesses a true current generator which adjusts the injected current so that it is always proportional to the command pulse amplitude (1 nA for 100 mV) and independent of the charge resistance.



[Click](#) to enlarge

Standard head-stage is HS-180. Three other head-stages are available for the VF-180. Choice is dependent upon current injection requirements. Head-stages can be interchanged without internal recalibration of the instrument. Each head-stage is fitted with a miniature, coaxial electrode holder with driver shield. Only 5 mm in diameter, gold plated and 50 mm long, the electrode holder is a masterpiece in design.

FEATURES

- ◆ High impedance head-stage
- ◆ True current generator
- ◆ Negative capacity compensation
- ◆ Oscillation burst (tickle) facility
- ◆ Electrode resistance compensation (Bridge)

Head-Stage	H-160	H-170	H-180	H-111
Input impedance (Ohm)	>1E9	>1E10	>1E11	>1E14
Recommended for electrode resistance	1-10MOhm	10-100MOhm	100MOhm	Ion selective electrodes
Bias current	<300 fA	<300 fA	<300 fA	<300 fA
Maximum current injection	10 μ A	1.0 μ A	100 nA	